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PROGRAMED LEARNING. REPORT OF A CONFERENCE CONDUCTED BY THE STATE DEPARTMENT OF EDUCATION AS PART OF THE OREGON PROGRAM (PORTLAND, FEBRUARY 6-7, 1964).

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THE IDEAS EXPRESSED AT THE CONFERENCE ARE SUMMARIZED. THE IDENTIFYING CHARACTERISTICS OF PROGRAMED LEARNING ARE GIVEN, ITS POTENTIAL IS DISCUSSED, AND THE PROBLEMS TO BE MET WHEN INTRODUCING PROGRAMED INSTRUCTION INTO A SCHOOL SYSTEM ARE DISCUSSED. SHORT DESCRIPTIONS OF THE USE OF PROGRAMED MATERIALS IN 12 OREGON SCHOOL DISTRICTS CONCLUDE THE REPORT. (MS)

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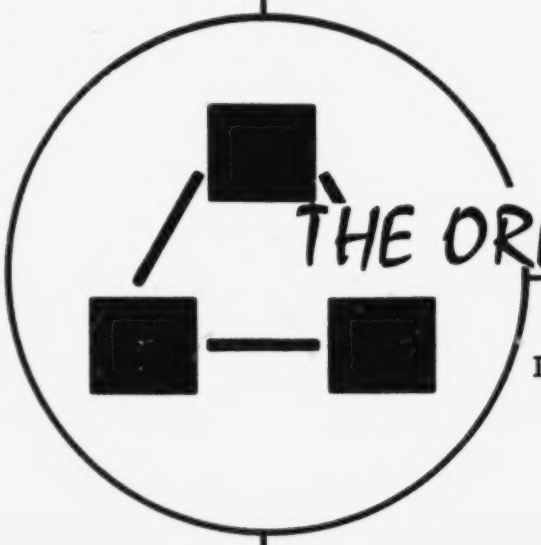

THE OREGON PROGRAM

A DESIGN FOR THE
IMPROVEMENT OF EDUCATION

Programed Learning

CONFERENCE REPORT

Oregon State Department of Education
Leon P. Minear, Superintendent

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

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Programed Learning

Report of a conference conducted by the State Department of Education as a part of The Oregon Program, on February 6-7, 1964, Sheraton Hotel, Portland, Oregon.

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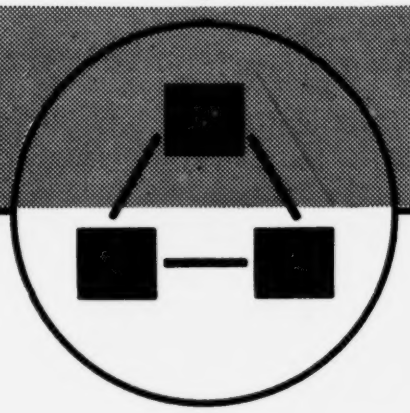
THE OREGON PROGRAM, a design to improve education in Oregon through statewide cooperation of local school districts, higher education, and the State Department of Education, provides Oregon educators with a means for communication, for sharing ideas and experiences, and for in-service education to assure that promising innovations can be successfully integrated into acceptable instructional patterns.



Foreword

One of the most dramatic developments in education in recent years has been the advent of the concept of programed learning and with it the teaching machine.

Programed educational materials, presented through automated devices, whatever the label, do represent a striking departure from the more traditional forms of instruction centered on text-book use or even on a broad range of audio-visual materials

There is a rapidly increasing interest in programed learning among Oregon school districts and many are experimenting with one or several forms of programed instruction.

The State Department of Education recognized the need for a general assessment of problems and progress, called the first Oregon Conference on Programed Learning in February of 1964 sponsored by The Oregon Program, and prepared this summary of conference activities for the benefit of Oregon teachers, parents, and administrators who are concerned with the quality of education.

I would like particularly to thank Dr. Willard Bear for his leadership as chairman of this conference, and Mr. Henry Ruark for his invaluable assistance. Their efforts made the conference successful. I am indebted also to Mrs. Evelyn Gunter, editor of this publication.

Leon P. Minear

Superintendent of Public Instruction

State Superintendent of Public Instruction,
Leon P. Minear, and Ralph Tyler, Director,
Center for Advanced Study in the Behavioral
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THE CONTEMPORARY CHALLENGE TO EDUCATION

An Address by
Peter H. Odegard
Professor of Political Science
University of California
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I want to talk tonight on the challenge of education, and I have been assured that I would not have to "fly low". When you fly low over the terrain, you see great detail. You see the kind of problems you people have been struggling with here today. But when you "fly high", you don't see all these details.

Tonight I'm going to fly high and talk about some aspects of education I know you all are familiar with. My purpose is not "to win converts, but to sustain the faithful".

Education, I realize, is a weasel word. It admits of many meanings. To speak of education and civilization, for example, can be an exercise in tautology. For if one thinks of education in its broadest sense, civilization and education are synonymous. Without education there is and can be no civilization. For it is through education of some kind, by precept and example, indulgence and deprivation, that civilizations are developed and maintained. Schools and colleges, research

Keynote

institutes, galleries and museums are merely the more formal part of the total educational process. Churches, theaters, trade unions, corporations, organized groups numbering into the thousands, radio and TV, books, newspapers and periodicals, not to mention the endless flow of other printed matter that circulates in our contemporary civilization, are also part of the educational system. So, too, are other forms of communication by which the great booming, buzzing confusion of the world is made viable, tolerable and, after a fashion, meaningful.

To speak of education in these terms, however, is to embark upon a boundless sea, and I do not propose to do that here. I may want to come back to the notion of education as civilization or civilization as education; but for the present I'd like to focus attention, if I may change the metaphor, upon a somewhat smaller screen.

Formal education has essentially two major responsibilities, one to the individual, and another to the society it serves. To the individual it offers understanding and opportunity; to society it provides for both stability and mobility, conformity and diversity, order and freedom. The educated individual in any society is one who understands the prevailing value system and the complex of customs and institutions to which that value system relates. With understanding goes a capacity not only for successful adaptation, i.e., conformity, but also for continuous and rational reflection on the civilization of which he is a part. Education, by promoting understanding, makes it possible for man to be a moral creature; that is, to accept, rationalize and adapt his conduct to the moral imperatives of the world in which he lives.

But education does more than make moral man a possibility. Through developing his understanding, it also makes possible a system of ethics. That is, education makes possible not only successful adaptation to prevailing patterns of human behavior, i.e., morality, but a continuous and rational reflection on the prevailing moral situation, i.e., a system of ethics. The educated man, the man of understanding and knowledge, is consequently one who, with minimal psychic tension or anxiety, can live with the past in the present without fear of the future and the changes it may bring - changes which he will no doubt help to produce. Education thus plays a major role in the liberation of the individual from the psychic tensions and anxieties that characterize civilization. The educated person is more tolerant of ambiguity, less xenophobic, more understanding, and hence more tolerant of cultural and political differences, less likely to appear in a divorce court, on the police blotter, or in a mental institution. He is less likely to be taken captive by ideological cliches or to give way to fantasy in defiance of, or indifference to, the facts of life. He is more likely to be-

lieve in the efficacy of political participation to effect rational changes in the social order and more likely to prefer peaceful persuasion to violence in bringing about changes in the political power structure. He is less likely to suffer from what psychologists call anomie; i.e., social, cultural, or political alienation. He is more at home in his family, his community, his country, and in a pluralistic universe – more stable and contented in the universe and at the same time more hopeful of the future and less fearful of change. He is, in a word, more civilized. Empirical evidence for all this is available in a growing literature on human behavior.

But education offers the individual not only understanding; it offers him opportunity as well – opportunity to grow in character and status, in power and prestige.

The high correlation between income and education, between social status and education, between education and political participation, influence and power has been repeatedly demonstrated. Education would seem to be a major, if not the major, factor in the upward social mobility of individuals in modern society. A 1952 study of college graduates by Ernest Haveman and Patricia West offers striking data on the opportunity coefficients of education. College graduates, they report, "hold the best jobs, the positions of greatest prestige..... By all conventional standards of worldly attainment, they have made good almost to the man." Eighty-four percent of proprietary, managerial, executive, and professional positions in the United States are held by college graduates who comprised less than nine percent of the total population gainfully employed. (See: They Went To College, 1952, p. 25). "Within our group (sample of 9000) at the time of the survey," write the authors of this study, "less than one-half of one percent of the male college graduates were among the unemployed; you would have had to hunt far and wide for a college graduate without a job." Various estimates have been made of the cash value of a college degree. Haveman and West reported in 1952 the median income of all men age 50 and above in the United States to be $2344, whereas the median income of college graduates 50 years and over was $6244. If one were to capitalize this income differential, the capital value of a college degree in 1952 would be in the neighborhood of $100,000. More recent estimates have

placed this figure at $250,000. (See T. W. Shultz, "Investment in Man," Social Science Review, University of California, June, 1959.)

Upward social mobility is almost universally related to education. Access to positions of prestige and power is open more readily to the educated than to the uneducated. In the public service a college education has become a prerequisite for appointment to nearly all positions beyond the most menial and unskilled. And specialized training even beyond the usual baccalaureate degree has become a condition of promotion and perferment within the service.

Nor are educational qualifications confined to the administrative or executive branch of government. Without a college education and, increasingly, without advanced graduate or professional training, the judicial and even the legislative branches are closed to those who aspire to either appointive or elective posts. Judges at all levels are expected, by custom if not by law, to hold not only an AB degree but an LLB. Congressmen and Senators and a vast majority of state legislators, governors, mayors, councilmen, and supervisors are today college trained men or women.

If education is a condition of access to the public service, it is also becoming increasingly the key to opportunity in private business, the professions, and even agriculture. Haveman and West pointed out that 84 percent of the proprietary, executive, and professional positions of all kinds in the United States in 1952 were held by college graduates. In law and medicine, the arts and sciences, teaching and the ministry, in the engineering and construction industries, in communications, transportation, trade and commerce, in fact in nearly every walk of life, there are fewer and fewer places for the uneducated man or woman. Not long ago, 1910, less than two percent of the total work force was composed of professional or technical workers. Today over ten percent of the total work force is so classified, and by 1975 professional and technical workers will approach 15 percent of the work force. And if one includes higher clerical and service positions, the percentage of jobs requiring education beyond elementary school and, in most cases, beyond high school, rises to approximately 50 percent of our work force even now. With increasing automation, the

disappearance of marginal and subsistence farmers, the increase in professionalized and service occupations, the percentage of jobs open to uneducated or poorly educated men and women will continue to decline. It is not surprising that the rate of unemployment among various segments of our population shows a high inverse correlation with the level of education.

The days of the uneducated, unskilled worker are numbered. Contrary to classical Marxist doctrine, the modern worker is not being so much proletarized as professionalized. Karl Marx, who, even in the 19th century, noted the growth of automation, assumed that the result would be not only to rob the worker of his job but of his skill and thus push him into the ranks of the unskilled or lumpen proletariat. What Marx failed to take into account was the role of education not only in restricting the supply of workers by keeping a larger and larger proportion of the population in school, but also by giving them education to meet the changing patterns of available employment. Whereas Marx saw capitalism as tending to reduce the importance of skilled labor by assembly-line techniques, the trend has been rather in the opposite direction of increasing the importance of skilled labor and hence the importance of education.

Education as the key to opportunity becomes more important not only in training the professional, technical, and clerical workers demanded by advancing scientific and technological frontiers, but also to make possible a more rewarding use of the leisure time which becomes increasingly available. If present proposals for a five hour day, a five day week, and a thirty week working year are realized, the responsibility of education will not be reduced but vastly increased. If we are not to spend most of our time in vapid idleness or playing bingo, we shall have to find more rewarding ways of using the otherwise vacant hours, days, and weeks that will be ours. The opportunity even now available to us for setting in motion a renaissance in the creative arts and sciences, in literature, music, and in the humanistic studies generally is breath-taking in its dimensions and its possibilities. For education can be the key to opportunity not only for gainful and useful employment but also for participation in the life of the mind and spirit, in the understanding and enjoyment of the world of nature and in expanding the horizons of human understanding and companionship.

I have said that education has a dual responsibility - to the individual and to society. Although they are similar, they are not the same. The opportunity for social and economic mobility that education makes possible has implications for society that reach far beyond the individual. The economics of education, for example, may well have a more important effect on a nation's Gross National Product and its rate of economic growth than those factors normally included in the equations and projections of the classical economists. To the classical tripos of land, capital, and labor we may have to add education as a major component of economic theory and analysis. The manner in which land and other natural resources are used, the pattern and rate of capital formation, the size, character, and mobilization of a nation's manpower probably depend more upon education than anything else yet. Beyond vague references to "cultural factors" or to the effect of religious and other value systems upon economic behavior, there has been little scientific analysis of the economics of education.

It is, of course, obvious to the most casual observer that in the United States and in other economically advanced countries, expenditures for education constitute a not inconsiderable part of the GNP. Within the public sector of the economy, the $25 or $30 billion a year spent on education in the United States (about 5 percent of our $600 billion GNP) ranks second only to $50 billion spent on national defense. And if one is to measure the total effect, the direct expenditures on education, like those on defense, must be multiplied several times. Teachers and others engaged in formal educational employment in 1960 in the United States exceeded 2,000,000 with a total payroll in the neighborhood of $10 or $15 billion. In these terms also education ranks second only to the armed forces within the public sector of the economy. Except for men and women in uniform, those employed by schools and colleges account for the largest single category of public employees in this country. Any industry of this magnitude must be regarded as a major factor in the economic life of the nation.

In addition to direct expenditures on instruction, administration, and physical facilities, one must also take account of the indirect expenditures represented by upwards of 50,000,000 students who spend all or most of their time in school. Not only do they comprise an almost unalloyed consumer market of vast dimensions, but they keep off the labor market millions of workers who might otherwise be competing for employment or for unemployment benefits. The effect of all this on the upward thrust of real wages, on the installation of labor saving machinery, and on the maintenance and stabilization of the market for consumer goods, would be difficult to measure.

Traditionally we have looked upon educational expenditures of all kinds, including the "income" or "production" "lost" by students as a social cost, as of course it is. The "income foregone" of students incidentally has been estimated to exceed the other direct costs of education. But might we not think of most expenditures on education not as costs but as investments? Might we not think of education as producing human capital in the same sense as the machine tool industry produces physical capital? If we do, we might then ask whether the rate of return on education as compared with the rate of return on alternative investments justified, in purely economic terms, the resources invested. Those of you who are familiar with the work on this

problem of Theodore Shultz, Mary Bowman, G. S. Becker, Harbison, and others, know something of the complexity and subtlety of the calculations involved. Many people have noted the apparent correlation between educational expenditure, GNP, and rates of economic growth. But it is not always clear whether increased productivity and income are the effect or the cause of increased educational expenditures. If productivity is a function of general vocational skill, and this in turn can be measured by the number of years of schooling of the active population, one ought to be able to calculate the relation between education and productivity. According to Professor Shultz, the "stock of education" (i.e., vocational skill of the labor force) in the United States in 1900 when the average worker had 7.7 years of schooling, was some 216 million years. By 1957, with an average of 11 years of schooling, this "stock of education" had increased to 776 million years, representing an annual total productivity addition of 3.3 percent, an impressive proportion of the total annual rate of growth. If one made this same calculation, taking into account only the increase in the labor force without reference to the average years of schooling, its contribution to the total rate of growth falls to .8 percent a year for this same period.

Various efforts have been made to calculate the rate of return on the nation's total educational investment by comparing the cost of educating a man and the total amount he receives in wages during his active life. G. S. Becker estimates a rate of 14.3 percent for a person who has continued his studies to the end of secondary school, and 9 percent for one who has continued them to the four years of college. Theodore Shultz, using 1958 data, estimates the return on high school education to be 11.8 and for a college education at 10.96 percent against an average return on all business capital of about 8 percent. Although this type of analysis is in its infancy, it would seem fair to say that "to date the estimate of returns from education compare favorably with those from business capital."

Studies made in other countries confirm those made in this country. Stanislav Strumilin of the USSR Academy of Sciences, for example, says their studies show one year of primary education can increase a worker's productivity by an average of 30 percent. Illiterate workers, on the other hand, apprenticed at a factory show an increase of only 12 to 16 percent.

"After four years' primary education," he says, "a worker's output and wages are 79 percent higher than those of a first category worker who has had no schooling. After seven years' study, an office worker's qualifications may be as much as 235 percent above the lowest level; after nine years' study...as much as 280 percent above and after thirteen or fourteen years' study...as much as 320 percent above." The national income of the USSR, Professor Strumilin reported, increased from 33.5 billion rubles in 1940 to 146.6 billion in 1960. Of this latter amount, some 23 percent or 33.7 billion rubles was attributable to "improvement in the qualifications of the labour force." Between 1940 and 1960 current expenditures on education more than trebled. "Over the same years, however, the addition to the national income due to higher and secondary education increased more than sixfold." The average returns, for the national economy as a whole, from investments in this sector of cultural development has thus broken all known records, increasing from 52 to 144 percent per annum.

(See: Charles Benson: "Teaching Methods and Their Cost," in The Economics of Education, Vol. XIV, No. 4 of the International Social Science Journal, 1962, p. 683.
See also: T. W. Shultz: "Education and Economic Growth," in Nelson Henry (Ed.), Social Forces Influencing American Education, Chicago, 1961.)

All of these efforts to measure in quantitive terms the economic value of education are admittedly crude. Nor can they provide any very accurate measure of the total impact of education on the economy. How can one measure the economic value of a literate or against an illiterate labor force or of research by men like Newton and Einstein, and Pasteur, or of thousands of other scientists, engineers, artists, and philosophers who have made civilization possible? And who can put a price on the personal growth and enrichment that comes to all men and women in the process of education? At least we know that the overwhelming burden of the evidence available points to education as a major - if not the major - factor in the economic life of our contemporary world.

But the economics of education are overshadowed by its contribution to other aspects of our culture and civilization.

Every society, if it is to survive, must somehow contrive to provide for both Order and Freedom, Stability and Mobility, Permanence and Change. Education affords the most effective means for accomplishing this. For it is through education, both formal and informal, that the heritage of the past is transmitted and an understanding of the values, customs, and institutions that have emerged through time is developed. It is thus a conservative force of great power and dimension --so powerful, in fact, that its contribution to conformity outweighs by a considerable margin its contribution to change. I do not argue that formal education in schools and colleges is the sole or even the major force working toward equilibrium and stability. The family, the church, the economic system, including the mass media, the courts, the system of legal rights and obligations tend more consistently and powerfully toward conformity than do the schools. Were this not so, human nature being what it is, organized society would present a spectacle of disorder and conflict not unlike the Hobbesian state of nature in which every man's hand would be against every other man, and life would be solitary, nasty, brutish and short. Formal education, too, by developing an awareness of the values and behavior patterns that give life and meaning to social institutions makes an indispensable contribution to that basic consensus without which no social order can operate or endure.

But survival of any social order requires not only stability but mobility and flexibility as well. Rigidly conformist societies governed by immutable traditions and irrevocable laws invariably stagnate or dissolve through failure to adapt to changes both in the external environment and in the internal behavior patterns of the society itself. Someone has said that the only certain thing in life is the certainty of change and that civilizations, institutions, and value systems like the individuals to which they relate must adapt or die. In this process of social change and adaptation, education, and especially formal education, must play a decisive role. This it can do by holding up for continuous and critical study prevailing value systems and institutions and the patterns of human behavior that presumably are governed by them. When values, institutions, and behavior are incongruent or in conflict, change of some kind is inevitable, and education through teaching and research can help to indicate constructive and orderly avenues of change. It can thus help to avoid the violent upheavals that characterize

social change in those communities in which education fails to play its proper role.

One sign of a mature and stable society is its capacity to effect social and political change without violence. The experience of mankind, not only scientific research, best tends to indicate that democratic values, institutions, and behavior patterns are better adapted to this process than are those of authoritarian or totalitarian regimes. It is not therefore surprising to note that democracy and education are so mutually compatible. Summarizing a considerable array of empirical data on the "conditions of the Democratic Order," Professor Martin Lipset has this to say in his book on Political Man: "Data gathered by public opinion research agencies which have questioned people in different countries about their beliefs on Tolerance for the opposition (i.e., for diversity), their attitudes toward ethnic or racial minorities, and their feeling for multi-party as against one-party systems have showed that the most important single factor differentiating those giving democratic responses from the others has been education. The higher one's education, the more likely one is to believe in democratic values and support democractic practices. All the relevant studies indicate that education is more significant than either income or occupation." (P. 56. See also C. H. Smith: "Liberalism and Level of Information," Journal of Educational Psychology, 39 (1948), p. 582; Samuel Stouffer, Communism, Conformity and Civil Liberties, N. Y., 1955.

The integral nature of democracy and education is indicated also by data which shows that those most committed to democratic values and institutions are also must committed to education - just as those most committed to education are also most committed to democratic values. What I have been trying to say is that the contemporary challenge to education is a challenge to our contemporary civilization, since the one is inconceivable without the other. If there is merit in this argument, we shall need to revise our ways of thinking about education. For centuries men thought of formal education as something of a luxury suitable for the sons and daughters of the privileged classes but unnecessary and inappropriate for slaves, workers, and peasants. And even where some education for the masses was deemed expedient, it was conceived as indoctrination in what Plato called "Noble Myths" to insure

their subservience or as vocational training of a narrow sort to insure an adequate supply of trained servants for the rich and the well born. With the emergence of the national state, emphasis was again more on indoctrination than on understanding or opportunity. As nationalism, in turn, gave rise to democracy, education was thought of as a necessary condition for political participation and economic and social advancement. Finally, in our own time as science and technology, themselves products of increasing education, began to transform a more or less simple, static culture into an increasingly complex and dynamic one, formal education came to be recognized not as a luxury or a political expedient but as an indispensable condition not only for orderly growth and development but for survival. To the individual it brought understanding and opportunity. To society it brought stability and the possibility of peaceful and orderly change. Thus, formal education, from being a peripheral factor in the maintenance and development of civilization, has now moved to the heart and center of civilization itself.

Yet we continue to think of education largely in such instrumental terms as education <u>for</u> citizenship, or <u>for</u> business and the professions, or <u>for</u> the advancement of science and industry. We continue to speak of education <u>for</u> life, as though education were something apart from life, although we know that to live is to learn. When learning stops, life stops. For in a swiftly moving culture the world will move on and leave us stranded and alone, alien to both our own time and to the future. Never before in human history has this been so true. Never before has the rate of change been so great in nearly every aspect of human life. Problems of understanding and adaptation are no longer merely periodic or cyclical but continuous. Almost before we have come to grips with Today, Tomorrow is upon us. Such a world poses an unprecedented challenge to education - a challenge that can be met only if we cease to think of education as merely a means to an end but like freedom, and equality, as both a means and an end in itself.

When the full implications of this are realized, we will find ourselves in an education explosion more revolutionary in its effects than the population explosion or even the knowledge explosion which, after all, are but by-products of education. To explore the implications of this education explosion for our

schools and colleges, I have proposed a more or less permanent Presidential Commission composed of men and women of the highest possible character and calibre, with a staff comparable in size and quality to that mobilized by the so-called Manhattan Project which ushered in the Atomic Age. For as historians have in the past written of the Hellenic Age, the Middle Age, the Age of Faith, the Age of Reason or the Enlightenment and the Atomic Age, so they may well write of the late 20th and early 21st centuries as the Age of Education. It is toward this prospect that we must turn if we are to meet the challenge and the opportunity of education.

What is programed learning?

Excerpts from an address by
A. A. Lumsdaine, Director
American Institute for Research
University of California at Los Angeles

In its most visible form, programed learning is a set of materials, quite diverse materials, not only in terms of subject matter, but also in terms of the way they are constructed and used.

To give us some common ground of reference we might look at one construction of programed instruction which historically has certain primacy and which does serve to identify three of the characteristics which are fairly common to all programed learning--the teaching machine.

All the devices we now call "teaching machines" use programed materials based upon some variation of the "Socratic", or tutorial method of teaching.

- ✓ There is continuous active student response to questions or exercises.
- ✓ There is prompt feedback and basis for correction of errors.
- ✓ Individual students proceed at their own rate.

These features, common to all teaching machines, implement the dictums that: first, the student will learn only what he does; second, learning is benefited by prompt reinforcement and knowledge of results; and third, individuals differ greatly in the rate at which they can learn and perform.

Allowing each individual student to proceed at his own rate, in a sequence most appropriate for his own needs, is a goal that has been sought in many ways by educators.

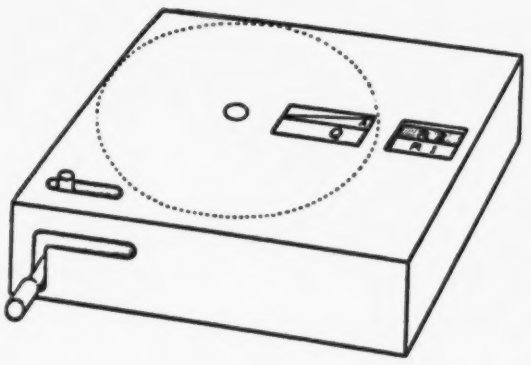
I am not certain that this characteristic, important as it is as a goal, is the most dominant characteristic of programed instruction. It is certainly an important thing, however, that if we can break the lockstep by which everyone is forced to proceed at the same pace, by any means whatever, including the use of programed instruction, we will have achieved a considerable gain in the use of our young manpower and resources.

By allowing each to proceed at his own rate, we will have gained not only a considerable savings in time for teachers and students, but also it may prove a means of salvaging students who might otherwise be lost by reason of their boredom or frustration.

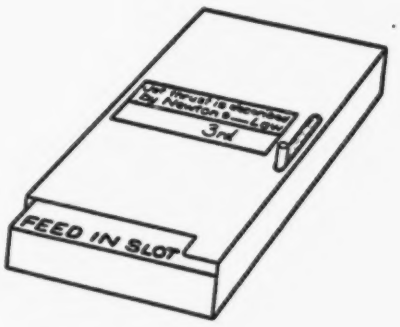
Even though most of the concepts of programed learning can be implemented without the use of machines, let us consider the teaching machine because of its historical importance.

It is Skinner's constructive-responding device which is related to the concept which really has changed the whole notion of the teaching machine to that of programed instruction, namely, the realization that an essential ingredient of any teaching combination that uses the equipment is what is inside the machine. Hence, the attention to a sequence system of programed material.

It is possible, with ingenuity, hard work, and intelligence, to devise programed material which will go beyond the notion of merely providing rote learning. It is possible to gradually lead the student into sequences in which he must solve problems, exercise ingenuity, and so on.



This machine, designed by B. F. Skinner really got the programed instruction movement under way. It provides the same kind of features as earlier machines except that it does not know whether the student is right or wrong. The student himself judges, and instructs the machine accordingly.



The earliest teaching machines developed by Sidney L. Pressey were originally conceived more for automating the quizzing or testing function than as automatic tutoring devices, even though from the outset it was clear that their immediate self-scoring features afforded important instructional values in addition to automatic testing capabilities.

Therefore, I would not, whatever other criticism might be valid with respect to programed learning, subscribe to the notion that it will never teach the student to think. A great deal of attention is being given to devising sequences in which the student is asked to discover and induce generalizations rather than being handed them in predigested form to be memorized.

It is possible to spend a great deal of time in study and research and production of programed materials, but any attempt to achieve program sequence must fail without an empirical approach in which the material is tried out with students in successive revisions to see where the stumbling blocks are.

Any initially constructed sequence, however expert the teacher or programer, when tried out on the student will be full of mistakes. This is part of the beauty of programed instruction--being able to find where the student will have difficulty and refine the sequence to almost guarantee an effective teaching job.

An enormous amount of work and humility is required to produce a program through this method. Many programs fail because of a common error--the relatively poor ability of even reasonably intelligent human beings to be able to anticipate how long it will take to do and how much it is going to cost.

There is some question whether the amount of resources needed to use our present understanding and empirical technique makes it economically feasible to produce programed materials.

The method and approach of programed instruction can be appreciated as a concept and can be usefully viewed as an approach that is worthy of experimentation and trial. But you cannot test a method. You can only test a program. We are presently working at this very thing--getting more data on specific programs and giving information concerning them to school districts to help them in making decisions about the use of such programs.

It should be remembered, however, that a single program cannot be used to make any general judgment of all programed learning.

The only approach that can be defended at the present time is that of looking at specific, individual materials, trying them out, getting some data as to what they do in terms of the achievement of students.

I hope your attitude will be one of intelligent skepticism, but friendly skepticism--maybe a tempered optimism. Be willing to try out, and be prepared for the likelihood of finding some programs that work successfully and some that do not. Be prepared, I hope, for a gradual, steady improvement in the quality of materials which will become available.

What is the potential?

Excerpts from an address by
Ralph Tyler, Director
Center for Advanced Study in Behavioral Sciences
Stanford, California

Educators who are considering the adoption of any innovation should determine first what the strengths and limitations of a program are and then determine what resources might be used to provide help where help is needed.

Qualifying objectives to be obtained is the first task that confronts a teacher. It is not enough to say that children will learn arithmentic or learn to read. Educators must be able to say, "These specific students should gain these particular concepts and be able to use them in these especial ways." Clarification of this kind is necessary for the teacher if he is to select wisely the tools he needs for his job.

Providing opportunity for practice in a particular skill or concept is the second step involved in instruction. Because it is necessary to keep the attention of an entire class, teachers have always had the problem of giving individual pupils enough time for the practice they may need. Workbooks and "seatwork" have been two of the methods teachers have used to provide practice materials for individual pupils and free themselves for other things that are essential.

Routine practice, however, does not result in increased learning. What does increase learning is practice which requires the continuous attention of a learner so that he is directly involved. This offers opportunity for well-planned programed materials which are sequential, are focused on the objectives and allow the student to move ahead at his own rate.

Motivation is another of the problems in achieving effective learning and programed material can be helpful to a degree in motivating pupils. When children first come in contact with programed material, it is novel and there is motivation in learning how to use it. After a certain point is reached, however, novelty wears off and this is when the teacher must be ready to supply added incentive.

Guiding desired behavior is a constant challenge. Many youngsters do not know what is expected of them and often, by the time they get to the high school level, they are convinced that all they must do is memorize material. They need direction for learning.

Again, it is possible that a program can guide the student--show him, step by step, what behavior he is trying to learn. With a good program, he is required to make answers that cause him to draw inferences, to make comparisons, to apply certain principles -- and thus a problem of guidance is solved.

Providing appropriate sequence so that students keep building on previous learning is another problem which has been overcome in a well-designed program. Appropriate sequence is a requirement of good programs and they can achieve it more effectively than many textbooks have been able to do.

Predicting and avoiding learning difficulties for individual pupils is a tremendously difficult task. Well-prepared programs undergo careful, arduous testing and revision which gives programers an opportunity to anticipate many of the difficulties students will have and prepare material which will avoid these difficulties.

Reinforcement or reward is an important part of learning. When programed material is used, one kind of immediate reward is provided because a student knows at once whether or not his answers are right. In addition, however, the teacher may often need to consider other kinds of reinforcement, such as periodic opportunity for the class as a whole to review what its achievement has been, or occasional words of encouragement to individual students.

Helping the student set appropriate standards for his own performance is the eighth condition for effective learning and here again, programed material might prove an efficient aid in making pupils realize whether they are doing well, or making them dissatisfied if they are not.

Evaluating what students have learned is the final step. To date I do not believe programers have faced the problem of determining how well students have learned, or how well they will be able to apply what they have learned to experiences outside the classroom.

Theodore Waller, Vice President of Grollier Society, and Melvin Barnes, Portland Superin - tendent of Schools.

Excerpts from an address by
Melvin W. Barnes, Superintendent
Portland Public Schools

Dr. Melvin W. Barnes, Chairman of the National Committee of Project Instruction, discussed highlights of the National Education Association's Project Instruction and conclusions which grew out of the project committee's investigation of programed materials as a teaching tool. He pointed out that twelve areas received major attention from the Project Instruction Committee. One of these decision areas had to do with instructional materials, technology, and space. Recommendations included the following:

- ✓ In each school system there should be one or two well planned instructional materials and resource centers consisting of at least a library and an audio-visual center. In each school building there should also be an instructional resources facility. These centers should be staffed by persons who are adequately prepared in curriculum and instruction, in library service and audio-visual education.

- ✓ Schools should make use, with proper supervision, of self-instructional materials and devices (programed instruction) that facilitate varied learning opportunities and continuous progress for learners of wide and divergent abilities. The use of programed instruction should be accompanied by a vigorous program of research and experimentation.

- ✓ A comprehensive study and action program is needed to improve the quality and use of printed teaching materials and other instructional media. This requires the cooperation of both the producers and consumers.

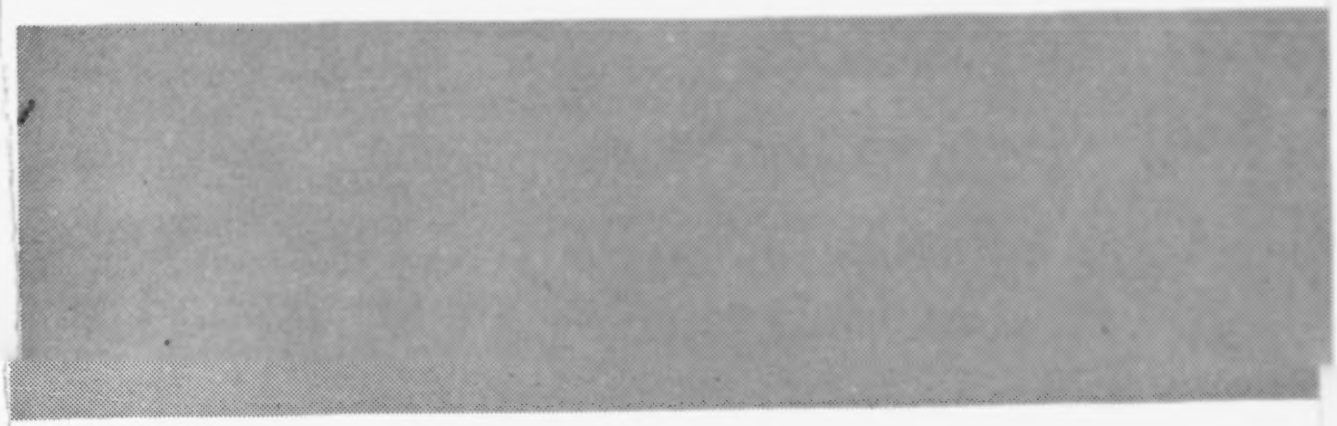
- ✓ School authorities should examine the potentialities of automation for storage and retrieval of pupil personnell data, instructional material, etc.

What are the problems?

A summary of ideas expressed in
panel and group discussions

The strategy of getting ready...

Planning for innovation can be the most valuable part of introducing new techniques into a school system. Programed instruction will work only as well as local attitudes permit, so it is important to know how to help teachers move into a changing pattern.



✓ A climate must be introduced into any school system for acceptance of new ideas. Teachers build security by establishing fixed patterns of operation, and unless they can be geared to change, it is difficult for them to break these patterns.

✓ The use of programed material should not be imposed upon teachers. Its use should grow out of their study of curriculum objectives and needs and their desire to correct some of the present deficiencies in classroom instruction.

✓ Administrators must often initiate dissatisfaction, discover inadequacies in the present system, build specific objectives, and determine where programed materials can supplement, rather than supplant, other types of instruction.

Group Discussion

College, school district, and State Department of Education staff members should work out a strategy that carries over several years of planning, training, getting necessary equipment, and following through beyond the two emotional stages -- enthusiasm and disillusionment -- to the stage where programed material can be used constructively as part of the entire array of teach - ing tools.

- ✓ Colleges and universities must sensitize new teachers to the need of accepting change and using new technological devices in the most advantageous manner.

- ✓ School systems need to build into their in-service training ways to expose teachers to new ideas and help them apply these ideas to their own teaching problems. One way is firsthand observation. Surveys have indicated that when teachers can visit other schools and see an innovation working effectively, they accept such innovations in their own classrooms more readily.

- ✓ For orientation purposes, teachers should write programs, but very few programs developed in this way are valid enough for classroom use. To do a good job, even on a very small unit of material, is a very time-consuming and demanding task. When teachers do plan to write programed material, some provision in terms of released time should be made for them.

- ✓ It should be remembered that use of programed material requires additional teacher time, rather than less, even though teachers are freed from supervision of routine practice. Teachers need more subject matter background when programed material is used as part of a total program.

- ✓ Parents will have no idea of what their role will be. Careful plans should be made for their orientation.

Mrs. Rosemary Luxton, Audio-Visual Supervisor of the Los Angeles Elementary Schools (shown above with Willard Bear, Assistant Superintendent of Public Instruction, Oregon State Department of Education), reported that the main hurdle in introducing programed learning into Los Angeles City Schools was negativism on the part of teachers and other educators. Antagonism resulted from lack of knowledge, and over a year of careful planning and orientation was done with all groups and at all levels, including parent groups.

The state of the art...

Increasingly, educational publishers will be putting emphasis on the production of programed learning materials, but the problems of production, selection, and use are beyond the experience of publishers and educators alike.

✓ **If programing is to become a widely useful technology, the art of writing programs needs to be reduced to communicable guidelines that can help to structure programers' activities. Currently, most attempts at programing proceed on a largely intuitive basis.**

✓ **There is no author in programed learning. There are programing teams consisting of persons with three kinds of skills -- a subject matter expert, an educational psychologist, and a program writer (akin to the technical writer). Most program publishers are beginning to use learning laboratories where every program is tested on groups of students, rewritten, then tested again.**

✓ **The philosophy has been to use programed material first where it fits best and then explore further uses. For this reason, programed materials have developed in skill areas because they so readily fill the need to provide learning through practice.**

✓ **Cost is a serious detriment to the production of such materials.**

There is more and more need for programed materials that meet specific objectives, rather than provide a total course. But is it economical to produce materials for specific needs?

- ✓ It may be feasible to produce programs that attack problems specific to a subject rather than to a locale. Teachers should begin to identify specific problem areas where programed materials would help and perhaps publishers could begin to find a commonality of needs that would justify production and wide distribution of small modular programs.

- ✓ Care must be used to insure that time and effort are not wasted in developing programs around units which are not significant to the total objective of the course.

- ✓ Teachers must be trained to the kind of diagnostic work needed to discover these needs. We do not spend enough time in diagnosis--finding out what children are really learning and why they are not learning more.

- ✓ Perhaps Oregon schools could designate certain staff members to relate to college and State Department consultants in the development of specialized programs which could not be developed within the district, and in the modification of curriculum to include programed learning. However, districts and colleges have not developed an awareness of the tremendous amount of time, effort and money involved in developing programs.

- ✓ If district administrators were organized somewhat like the Greater Cleveland Council to identify specific problem areas common to all, it might be possible to develop programs to meet these needs by marshalling all the resources of the districts, the State System of Higher Education and the State Department of Education.

Orchestration of materials...

Orchestration of materials was a phrase frequently used during the conference to define the objective of every school district being interested in the integration of technology and instruction to produce effective learning.

When a program has been achieved through which individual students can proceed, each at his own rate, toward building up gradual, cumulative mastery of a subject in a controlled, effective fashion, there is strong reason to believe that the use of such a program will be far more efficient in the use of the teacher's time, far less frustrating for the student, and far more effective from the standpoint of achievement than conventional modes of instruction.

There is danger that teachers will use programed materials without changing any of the other things they are doing in the classroom. They must learn how to modify present methods to complement what is already being done.

The objective, however, must not be to use machines or programed materials. The objective must be to educate children, and programed learning should be used as and where it is needed.

It is too much to expect that any one program, no matter how carefully developed, will eliminate all learning difficulties. It is for the crucial job of handling these contingencies that the teacher reenters the picture to redirect the student, provide a remedial program, or work individually with students who need his special attention.

Many districts reported that time has been wasted because a valid method has not been found for determining where programed materials may be used most effectively.

Participants suggested that a whole array of programs built around specific problems of students might be the most valid approach.

- ✓ Programs might be used for "repair jobs" or for enrichment needs that might otherwise escape the time, if not the attention, of a teacher.

- ✓ If programed materials are to be used for enrichment or remedial work, large quantities of them, easily accessible, indexed, and compatible, must be supplied.

- ✓ Teachers who use them will need to know enough about the subject to make a diagnosis of need on an individualized basis and this would require fairly frequent scanning of each child's present status in relation to the objectives of each particular area.

- ✓ Carefully developed programed materials might be used to teach those concepts which most instructors have been unable to teach. The need to teach economic concepts is one of the challenges most schools have been unable to meet. This is an area in which programs could be developed and used to great advantage.

- ✓ Study clinics with a library of programed materials might be used for remedial work.

- ✓ Colleges have found that programed learning has created a revolution in extension teaching, adult education, and correspondence study.

Group Discussion

- In relatively small and understaffed schools where not all teachers are equally prepared to teach everything to everybody, programs have been of considerable benefit. Teachers use program content and procedures to bolster their own instructional techniques.

- Another use has been discovered for programs in small schools which may have qualified teachers, but have too few pupils to make efficient use of the regular classroom process. Such schools extend a course in algebra or language, for instance, via the adjunctive use of programed material and occasional sessions with a skilled and competent teacher.

- Schools are using programed materials in special education, in telephone teaching and hospital teaching. Some areas are planning to use programed materials in Braille.

What some Rogers districts are doing

As reported by
district representatives
attending the conference

BEAVERTON PUBLIC SCHOOLS
Thomas Woods, Superintendent

The Beaverton District has developed no definite plan for examination and introduction of programed materials. Programed materials are being used on a trial basis in several areas of the curriculum, including high school mathematics, business education, and high school English, mainly as a result of interest on the part of an individual school principal or teacher. English 2600 and 3600 and Temac materials are used primarily for remedial work and for use with advanced students in special cases. The schools are in the second year of using programed materials.

BEND PUBLIC SCHOOLS
R. E. Jewell, Superintendent

The Bend school system does not make extensive use of programed materials. Various teachers have used programs in isolated cases for the solution of specific problems with individual students or simply for the purpose of experimenting with the use of these materials.

The nearest to a sustained effort has been made in the junior high school where Temac mathematics, English 2600 and SRA reading materials have been used in certain classes.

LAKE OSWEGO PUBLIC SCHOOLS
Nathaniel H. Moore, Director

The Temac Basic Mathematics Program has been used for two years with a group of 13 slow-learning or retarded pupils in the tenth grade. The students meet as a group but each progresses at his individual rate. Results of this trial program are considered only fair and it is being evaluated to determine whether or not it should be continued.

LANE COUNTY PUBLIC SCHOOLS
Lloyd Lovell, Assistant Professor, School of Education
University of Oregon

Last year Eugene furnished several classes for the Stanford study of the programing of SMSG math materials. Classes varied in the amount of direct teacher help available to the pupils, and the classes using programs were compared on achievement tests with classes using conventional teaching procedures with the same content. Very preliminary and tentative conclusions were that the SRA program was better than the SMSG programs, but conventional classes excelled the program classes.

In one Lane County school, English 2600 was used as the major instructional source, while during the same year another similar school used that program only for supplementary material with students in the lower half of the achievement distribution. The latter school is not using that program this year because the teacher of last year has left and her replacement is either not familiar with or not convinced of the usefulness of English 2600.

Last year, this school also used English 3200 for supplemental "enrichment" for several college prep students.

One small school, forced to use "multiple-class" arrangements in its mathematics program, used the Temac Algebra I and II programs for certain students while other pupils in the same class were using conventional materials dealing with other content.

Another small school having an excellent mathematics teacher and several high-achieving, highly motivated students, organized a senior math seminar. At one time, three students were using three different math programs on a tutorial basis while several other students were simultaneously working in conventional procedures dealing with still a fourth mathematical content. During this year two or three students who were busy in the math seminar decided to buy the Temac calculus program voluntarily and use it as an extracurricular study content with the voluntary help of the instructor.

McMINNVILLE PUBLIC SCHOOLS
Fred Patton, Superintendent

The McMinnville schools are using Temac materials for high school algebra, geometry, and trigonometry and Spooner materials for mathematics enrichment in the sixth grade. English 2600 is used for basic instructional purposes in the high school. Teachers and administrators are attempting to evaluate the use of these materials to find out what purposes they can best serve in the instructional program. The district is in its second year of using programed instruction.

MEDFORD PUBLIC SCHOOLS
Leonard Mayfield, Superintendent

English 2600 and 3200 are used in junior and senior high school classes, on an individual basis, for review and remedial purposes. Programed materials are used for teaching geography concepts and terms in the junior high school. A staff member is developing programed instruction materials for music theory in the elementary and junior high school general music classes. A committee of teachers is studying the possibility of using programed materials on science concepts and terms in grades 7-8. Another committee is examining materials, looking toward their use in developing understandings and perceptions of creativity.

MILWAUKIE PUBLIC ELEMENTARY SCHOOLS
Arthur Kiesz, Superintendent

There is some question as to whether or not the SRA reading materials are properly classified as programed instruction, but these materials have been used extensively for the past five years in two of the district's elementary schools and to some extent in the others. The SRA reading materials are used as the basic reading program in grades 1-6 and for remedial purposes, in grades 7-8. The district believes that it has had good success with these materials and plans to continue their use.

MILWAUKIE UH5
Owen Sabin, Superintendent

Union High School District #5 in Milwaukie introduced programed learning at its Clackamas High School in September, 1961, with a four-year sequence using Temac materials.

The program, as introduced formally in 1961, is now in its third year. At its inception 48 carefully selected students, with the approval of their parents, started a program designed to see how much mathematics could be learned in four years.

Thirty-four students remain in the experiment and their progress differs considerably, as might be expected. Four of the most advanced students will start on analytical geometry by the end of this year. All of the students have progressed beyond the normal rate. The district has started a new group each year since 1961.

PARKROSE PUBLIC SCHOOLS
Victor Cullens, Superintendent

English 2600 is being used in several classes for review and supplementary practice purposes with success. During the 1962-63 school year the Temac mathematics materials were used at the high school level and abandoned after one year of use. The staff is studying a variety of other materials.

PORTLAND PUBLIC SCHOOLS
Norman Hamilton, Assistant Superintendent

A variety of programed materials for individual study are located in learning resource centers where students spend a part of each week in self-directed study at Marshall High School. Materials found most useful for this purpose are not the complete course type but unit materials designed to strengthen learning in specific areas where the need is indicated.

Temac Mathematics is used in the Girls Polytechnic High School

where the traditional math approach is favored. All the other high school math programs use the SMSG programs as basic teaching material. Experience with programs used in teaching machines has not proved satisfactory because of pacing limitations and because materials are not available for students to take with them to study areas or for home study. English 3200 and 3600 are used in several high schools for specific review and practice needs. The Portland District is field testing all materials being published by Altoan and Coronet. Short programs are used for teaching vectors in physics and longitude and latitude facts and concepts in the elementary schools. Britannica's math workshop is being investigated for possible use in the primary grades.

REYNOLDS PUBLIC SCHOOLS
Hauton Lee, Superintendent

English 2600 is used as basic learning material in grades 7-8 for instructing class groups. The material is used only when practice on specific skills is required. English 2600 is also used for remedial purposes in high school English classes. The SRA reading program is used in the elementary grades.

STAYTON UNION HIGH SCHOOL
Merlin Morey, Superintendent

With the direction and cooperation of Teaching Research, Stayton Union High School is currently engaged in two projects for developing and testing teaching techniques and programed materials.

One project is concerned with teaching library procedures to 9th graders. The teacher's needs for teaching materials (transparencies, etc.) are interpreted and developed in the laboratory of the Instructional Materials Center at O. C. E.

Results are being recorded and measured in controlled situations. The materials in this project are not available for distribution at this time. No doubt Teaching Research will publish the results, and perhaps, cause the materials to become available.

In the second project a Stayton teacher has designed and is programing a "machine" for teaching basic electricity. The machine has been built and the first series of program frames has been completed.

This machine is of a kind that can be built at low-cost by students in industrial arts.

Further information will be published by Teaching Research.